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MEMORANDUM

To: Theresa A. Dunham, Somach Simmons & Dunn

From: Michael (Mike) J. Day, P.E.

Subject: Technical Memorandum on Regional Water Board's Administrative Civil Liability Complaint Issued to Del Mar Farms

Date: July 3, 2012

BACKGROUND

Somach Simmons & Dunn requested technical input from me regarding the Regional Board's Administrative Civil Liability Complaint (Complaint) issued to Del Mar Farms on May 14, 2012. The Complaint stems from three inspections conducted by Terry Bechtel (Bechtel) on May 19th, July 6th, and July 19th of 2011. Lieutenant Phil McKay of the California Department of Fish and Game (DFG) accompanied (Bechtel) on the July inspections. Based on the data Bechtel collected and his observations, the Regional Board alleges that the drainage from Del Mar Farm's fields was violating the Coalition Group Conditional Waiver of Waste Discharge Requirements (Conditional Waiver) from irrigated lands for increasing the turbidity in the San Joaquin River (SJR) above the Basin Plan's thresholds. The Regional Board recommends an administrative civil liability in the amount of $123,191.

Del Mar Farms grows tomatoes at the corner of Highway 33 and JT Crow Road. The fields receive water from Central California Irrigation District's (CCID) Main Canal. At the time of the inspections Del Mar Farms was furrow irrigating the tomatoes. They have since installed subsurface drip systems in those fields. Tailwater draining from the fields discharges into drains connected to the Amaral Line. Under normal operating circumstances, drainage water and sediment from fields irrigated by subsurface drip systems would be greatly reduced versus furrow irrigated fields.

I reviewed the Regional Board materials sent to me on June 21, 2012. On the morning of June 26th I met Zach Maring and field-reviewed the fields in concern and other fields in the vicinity served by the Amaral line and/or draining to it. And, I field reviewed the Amaral ditch outfall at the River. On the same day, I also met with Chris White, the Manager of Central California Irrigation District, to learn more about the District's irrigation and drainage systems in the area.

I also reviewed information Chris White sent via e-mail on June 29th, in request to an information request from Jon Maring. That information included a "Map of Amaral Drainage of Irrigation Paths" (with field numbers and drainage paths into the Amaral line), field irrigation records for the dates of concern (showing canal sources, fields irrigated, flows, and time of any flow changes by field number).

The Amaral Line is an approximately 4 mile long pipeline that runs parallel to JT Crow Road and spills into the SJR. The upstream half of the Amaral Line is a buried pipeline and the downstream half is unlined ditch. In addition to receiving irrigation drainage, the Amaral line receives water from the CCID Main Canal and delivers it to many fields south of J.T. Crow road (indicated by green arrows on map provided by CCID) besides some of Del Mar Farm's fields, which are the subject of the Complaint. Because of its dual function, often times the drainage water is diluted with irrigation water, and is diverted and applied to the fields of downstream water users.

There are many control boxes along the Amaral Line that are used to control and divert water to fields for irrigation. The control boxes have a rectangular footprint and protrude into the ground to varying depths. In the center of the boxes are a weir and canal gate used to control the water level upstream. The irrigation turnouts are on the upstream side of the box and the drainage inlets are on the downstream side. **Figure 1** shows the inside of a control box (photo taken during my field review).

Figure 1
Amaral Line Control Box

When farmers on the Amaral Line do not use all of the irrigation and drainage water, the excess flows into the River.

The outfall of the Amaral Line in the River consists of a pipeline protruding from the embankment with minimal erosion control (i.e., rip rap) (see **Figure 2,** also taken during my field review).

Figure 2
Amaral Line Outfall to SJR

Irrigation Systems

Bechtel noted that 2011 was Del Mar Farm's first year farming these fields. It was indicated to him that they were going to use surface irrigation the first year and install a drip irrigation system the following year. The Complaint appears to suggest that Del Mar should have installed the drip systems before the July 6th and July 19th events, and bases penalty calculations on that assumption.

It should be noted that tailwater runoff containing substantial amounts of sediment is not unusual in the area. Tailwater runoff from furrow irrigation is a normal practice, and occurs when irrigation water in the furrows advances to the end, and continues until sufficient water has infiltrated into the soil throughout the length of each furrow to uniformly irrigate all of the furrows in a "set". It continues for some time after flows are stopped at the head end and shifted to a new set of furrows. The relative steepness of land in the Crows Landing area increases the velocity of flow in furrows, erosion, and turbidity of tailwater compared to flatter lands in other parts of the San Joaquin Valley. I observed that all of the furrow irrigated fields in the area had signs of substantial erosion in the fields and of high sediment concentrations in tailwater drains.

From my experience, it is unreasonable to assume that drip systems could have been installed in Del Mar's fields that are the subject of the Complaint before July 6th and 19th of 2011, given the dates of notification by the Regional Board. This is because it takes several months to design, bid, order and receive materials, then construct the systems. Furthermore, the installation of buried pipelines and drip lines must be done after crops are harvested, because installation would severely damage the crop. Thus, installation prior to irrigations in 2012 was a reasonable response.

Drainage Flow Rates

During the inspections Terry Bechtel estimated the dimensions of the ditches and velocity of the water to calculate the flow rates. The May inspection flow rate was calculated for the outfall into the SJR to be 643 cubic feet per minute (cfm). But that calculation clearly has an error. Given the measurements cited, it should have been calculated at 315 cfm or 5.3 cubic feet per second (cfs), which is the flow rate identified on photo 4 of 4 in Attachment C for the May 19, 2011 event. But, that doesn't seem to affect the calculation of penalty for the May 19 event because the penalty limit for that day wasn't set by gallons of discharge, but rather by $5,000 per day. However, to the extent that the Regional Board relied on the May 19 flow rates for the other two events, it is important to note the correct calculated flow rate.

It is notable that precision to the hundredth of a gallon per minute (gpm), or even 10 gpm, is not possible given the accuracy of measurements taken. There is also a curious reduction factor in dimensions for some width and depth measurements. These may indicate a lack of practical experience.

Also notable, but inconsequential, in photo 2 of 4 for the May 19, 2011 event of the Complaint's Attachment C Discharge Event Photos, it states "the flow rate of the field discharge was similar to the 19 July 2011 event". I compared the May 19th photo to photo 2 of 5 for the July 19th photos in the same attachment. It appears the drainage flow rate is greater on July 19th than on May 19th. This is apparent because the board across the drainage stream in front of the drain inlet in the May 19th photo is exposed. However, in the July 19th photo the board is submerged indicating a higher flow rate.

CCID Water Delivery and Drainage Data

I combined CCID data to make maps for each day in question of fields being irrigated by the ditch/pipeline feeding it (yellow highlights and arrows with irrigation flow rates in blue added by me). Red arrows were provided by CCID (verified by me) indicating fields draining to the Amaral line. I also handwrote "Drip" or "Micro" in fields not irrigated by surface irrigation.

For each day, it was apparent that furrow irrigated fields owned by others that drain to the Amaral line (orange perimeter highlighting added by me) were likely to be adding drainage water and sediment downstream of Del Mar Farms' fields involved in the Complaint.

On July 6th and 19th it was also apparent that fields downstream of Del Mar Farm's discharge into the Amaral line were being irrigated. Photos 3, 4, and 5 for July 19th in Attachment C to the Complaint document the dilution and diversion effect (described above) to Del Mar Farms' drainage discharges resulting from irrigations by others in the Amaral line downstream of Del Mar's fields. The following dilution calculations were performed using CCID irrigation flow records to downstream flows with Bechtel's drainage flows and turbidity measurements on CCID and drainage water:

1. July 6th in Amaral Line: the drainage water would have been diluted to between 219 mg/L and 397 mg/L total suspended solids (TSS) by the fresh irrigation water delivered to field 514.
2. July 19th in Amaral Line: the drainage water would have been diluted to 218 mg/L TSS by the fresh irrigation water delivered to field 514.

It is also important to note that on July 6th and July 19th fields upstream of the Del Mar's fields receiving CCID water from the Amaral Line would have spill over the boards in control boxes adding further to dilution of Del Mar's drainage water.

Sampling

During Bechtel's inspections, samples were taken of the supply water, drainage water as it left the field, water in the control box, irrigation water from a nearby corn field, water at the Amaral Line outfall to the river, and SJR water up and down stream of the Amaral Line outfall, depending on the event in question. The number of samples, and location of samples taken was not consistent from one event to the other, based on the information contained in the ACL. The main constituent of concern in the samples was turbidity. Turbidity is the cloudiness or haziness of a fluid caused by individual particles that are suspended in the fluid.

How and where samples are taken can have a profound effect on the turbidity of the sample. The initial drainage from furrow irrigation typically has a higher turbidity than later in the irrigation. This is due mainly to the fact that the easiest particles to go into suspension are picked up by the wetted front.

In shallow water, like the field tailwater drains, it is extremely difficult to obtain a sample without stirring up sediment at the bottom of the drain and increasing turbidity. The inspection reports do not provide specifics about sampling methodology or instrument calibration. Any information with respect to sampling methodology and instrument calibration should be reviewed when made available. In the absence of such information, it is difficult to evaluate the quality assurance/quality control measures taken when the samples were collected and analyzed.

The River samples taken downstream from the outfall certainly were taken at a location where not much blending with upstream water had occurred, and thus may not represent a fair location to check for River turbidity objective. Regional board photos, my field observations, and River flow data demonstrate the lack of blending occurring only 100 feet downsteam of the Amaral drain outfall. The outfall is located on the far bank of the slowly-flowing and very wide river as it makes a U-turn. The outfall's location on the turn, along with the river's wideness, brush and other surface obstructions, and associated slow velocity result in outfall water "hugging the bank" without much blending. The San Joaquin River flows for the three days in question ranged between 2,000 to 6,000 cfs (measured by the U.S.G.S. at Crow Landing on those days). These San Joaquin River flows are 400 to 1,200 times higher than outfall flows estimated by Terry Bechtel on May 19th, which are the only outfall flows estimated for the three days in question. Even if one was to assume that the end of field turbidity measurements represented the turbidity discharged to the San Joaquin River from the Amaral Line on those three days, and that the May 19th outfall flow estimate was representative of all three events, actual increases in River turbidity would be on the order of 1% or less after complete mixing occurs, which is well below the 20% increase that is part of the objective cited in the ACL.

Other factors contributing to turbidity in the discharge at the outfall may be sediment previously discharged from other fields and remaining in the pipeline and the section of the Amaral Line that is an unlined ditch. Once the sediment is in the pipeline or ditch it can settle out when the velocity of the water is reduced enough that it is no longer kept in suspension. The minimum velocity to keep solids in suspension is approximately 1.5 feet per second. In the Amaral Line, sediment would be deposited and re-suspended as the flow rate fluctuated.

It was also apparent in the photos and by review of the River during my field review that sediment from the bottom of the River was being stirred up and re-suspended from the bottom of the River by the turbulence from the Amaral drain outfall. This undoubtedly increased turbidity 100 feet downstream.

Turbidity and Total Suspended Solids Data

Turbidity measurements rely on field measurements with a nephelometer, which measures the amount of light that passes through a vial with a sample of the liquid. The presence of particles is attributed to less light being detected. Typically, the procedure for using the unit is to calibrate it using pre-prepared vials that contain various concentrations of suspended silica particles in water. Periodic calibration and frequent cleansing with deionized water (or similar product) is a must for accurate readings.

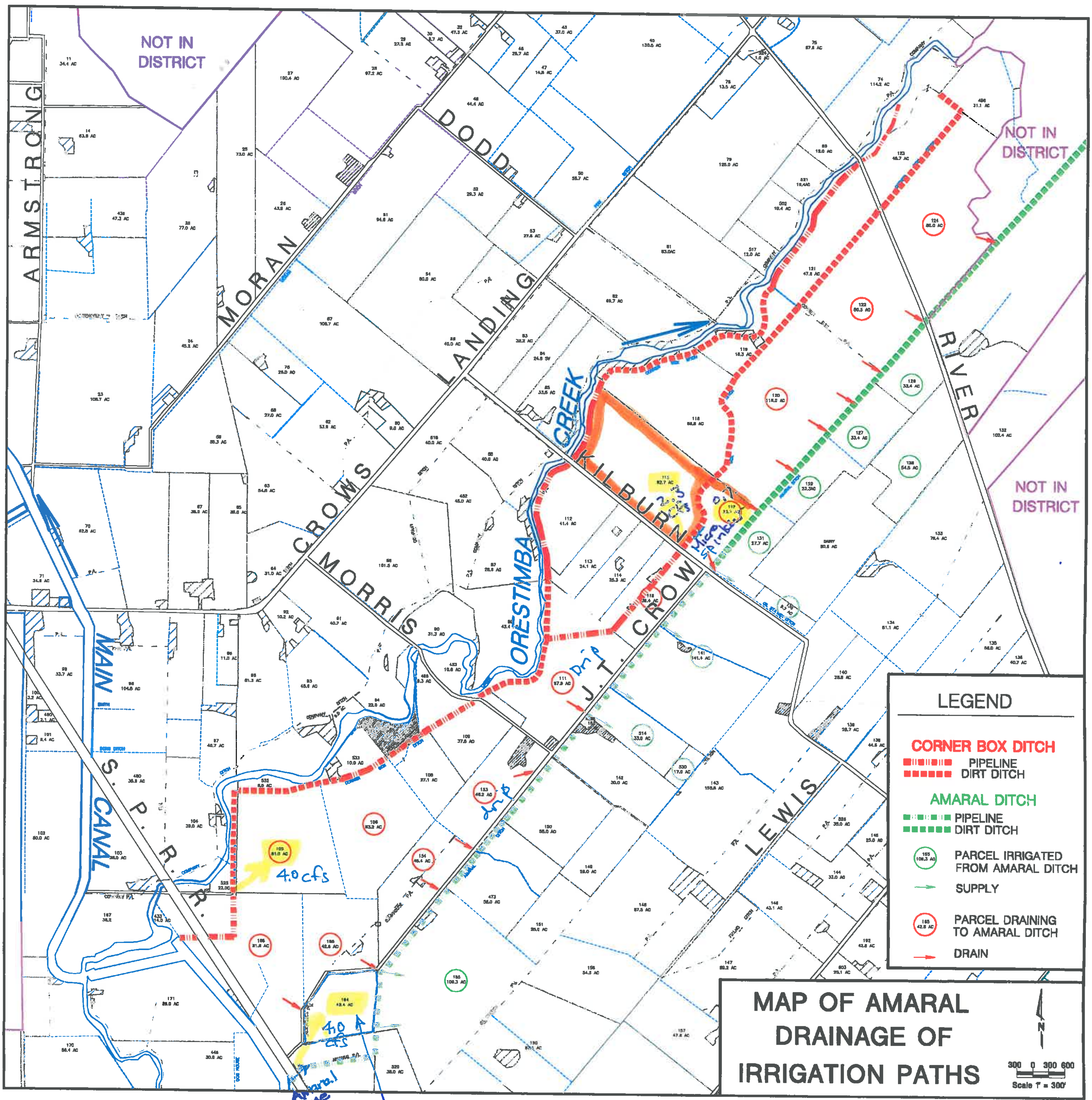
Total Suspended Solids TSS, measured in the lab, involves evaporating water from a weighed sample of previously collected water with only suspended solids (not including bottom sediment), and weighing the remaining solids after evaporation. Protocols for correct sample handling and laboratory analysis are also important for accurate results.

One milligram per liter of suspended silica calibration water correlates to one NTU. But, the light passing properties of most sediment varies versus the silica containing calibration vials. Thus TSS of water will usually vary from turbidity.

A summary of data from the Complaint Attachments follows in **Table 2**.

Inspection Date	Sample Location	Turbidity, NTU	TSS, mg/L
19-May	Irrigation Supply	42.7	-
	Field Drainage	544	-
	SJR u/s	25.6	-
	SJR Outfall	671	-
	SJR d/s	52.1	-
6-Jul	Field Drainage (13:00)	668	1,220
	Field Drain Box	739	1,840
	Irrigation Supply (north side)	111	108
	Irrigation Supply (RR tracks)	107	239
	Irrigation Supply (main canal)	-	135
	SJR u/s	-	40
	SJR Outfall	-	434
	SJR d/s	-	63
	Field Drainage (14:25)	585	486
	Corn Field Drainage #1	141	-
	Corn Field Drainage #2	84.5	-
19-Jul	Irrigation Supply	45.4	119
	Field Drainage	332	572

The inconsistency in what was sampled and analyses performed resulted in no documentation of River turbidity on July 19th, and only TSS in the River on July 6th.

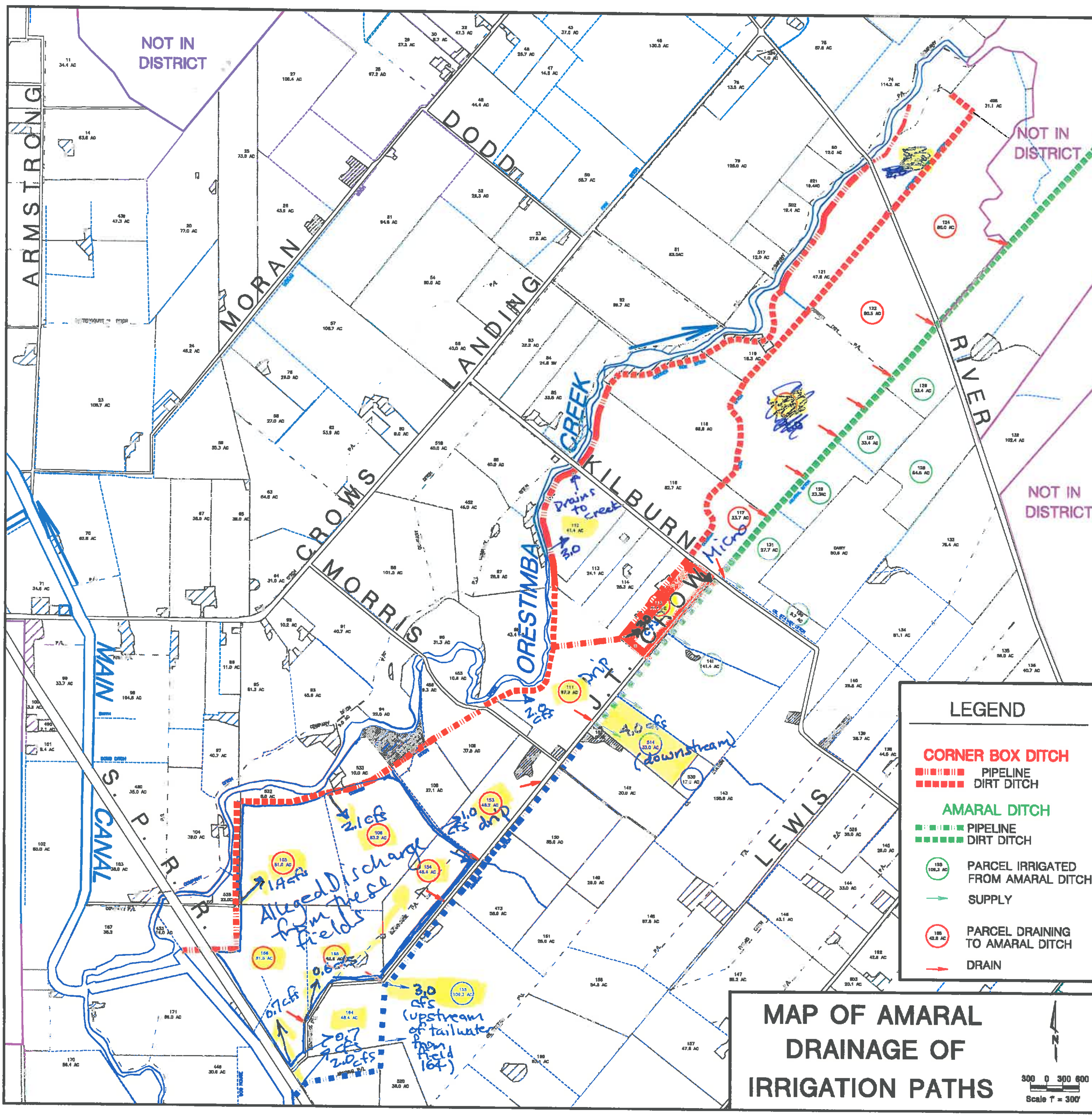


Alleged discharge from these fields

May 19, 2011

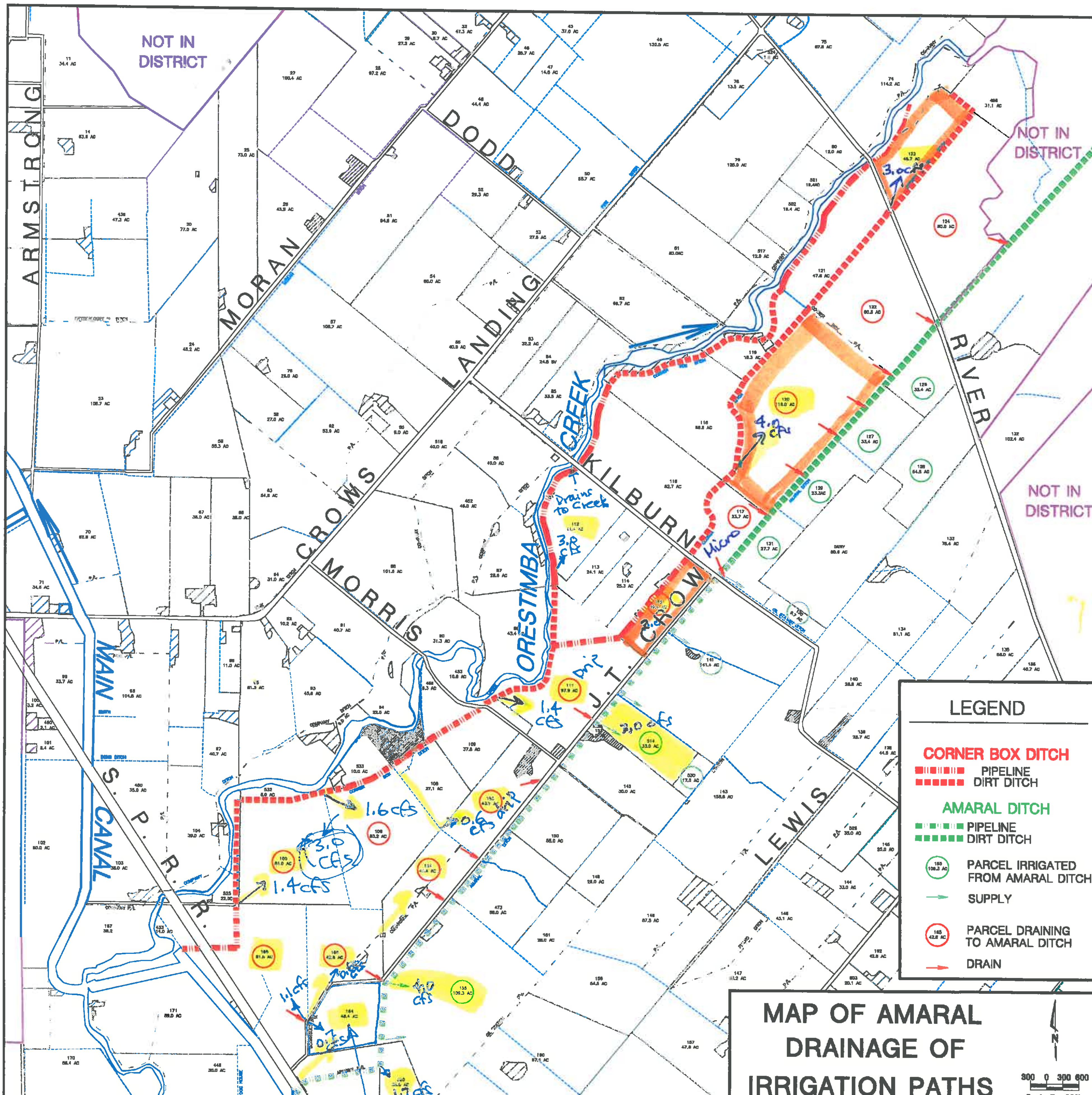
Yellow = being irrigated

Orange = likely discharge by others beside Del Mar to Amaral line.



July 6, 2011
Yellow = being irrigated
Orange = likely discharge by others beside Del Mar to Amaral line.

Exhibit B



Alleged discharge from these fields

July 19, 2011

Yellow = being irrigated

Orange = surface irrigated fields that drain to Amaral line besides Del Mar's

Exhibit B

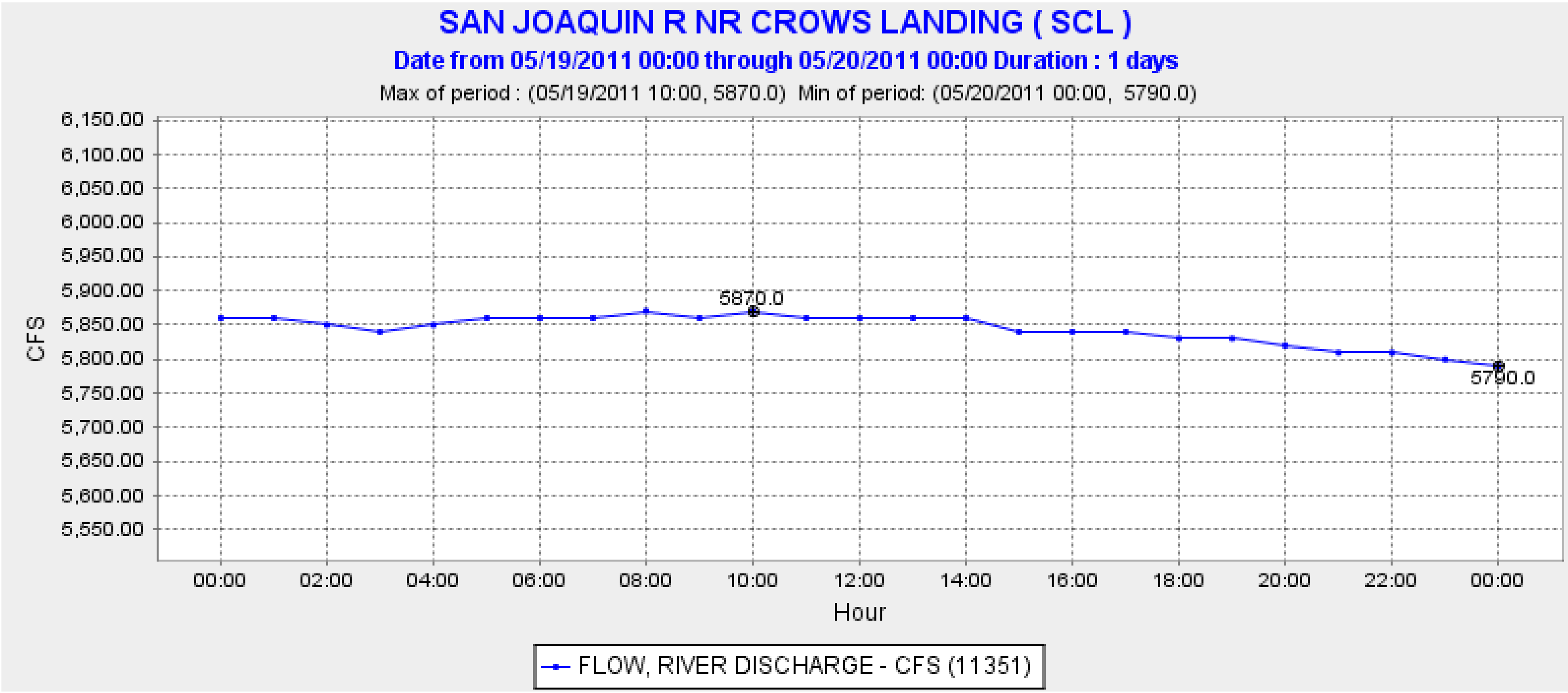


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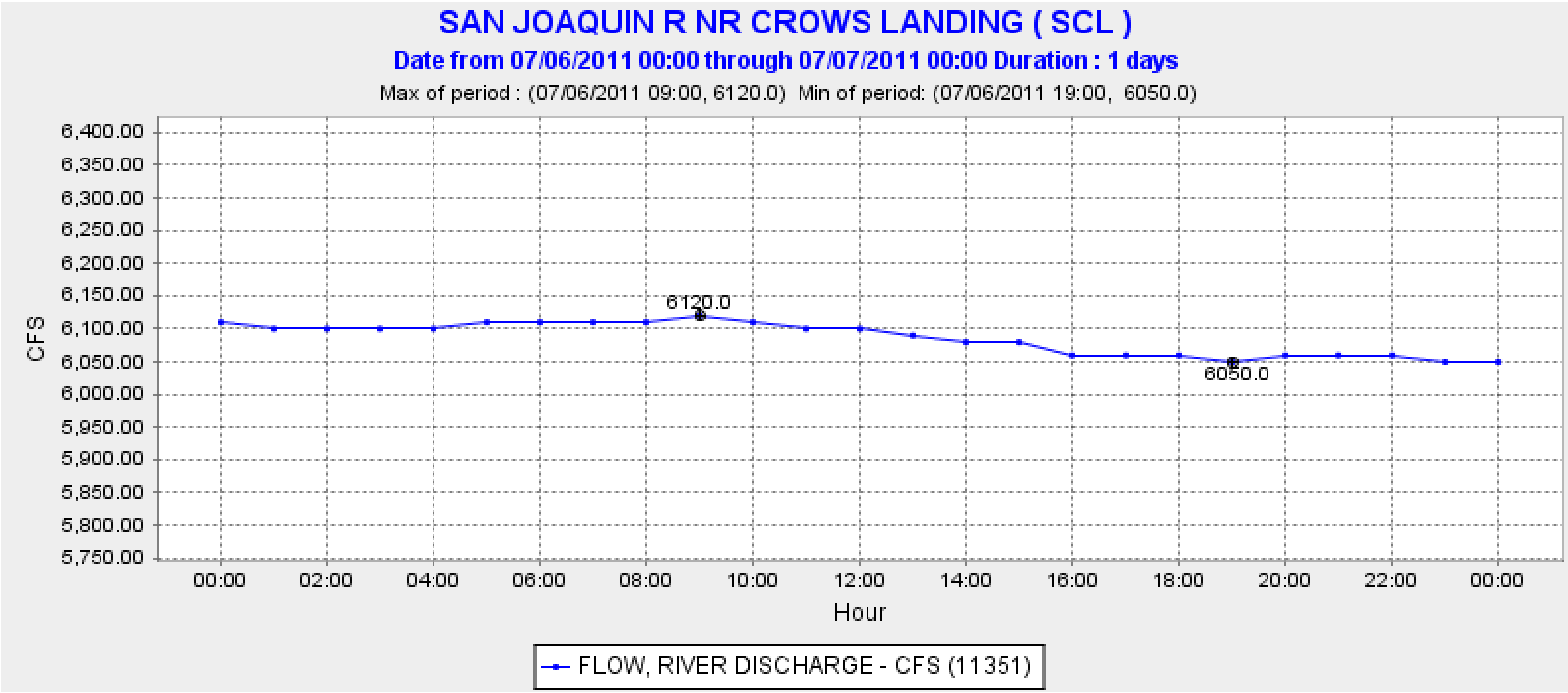
Exhibit B



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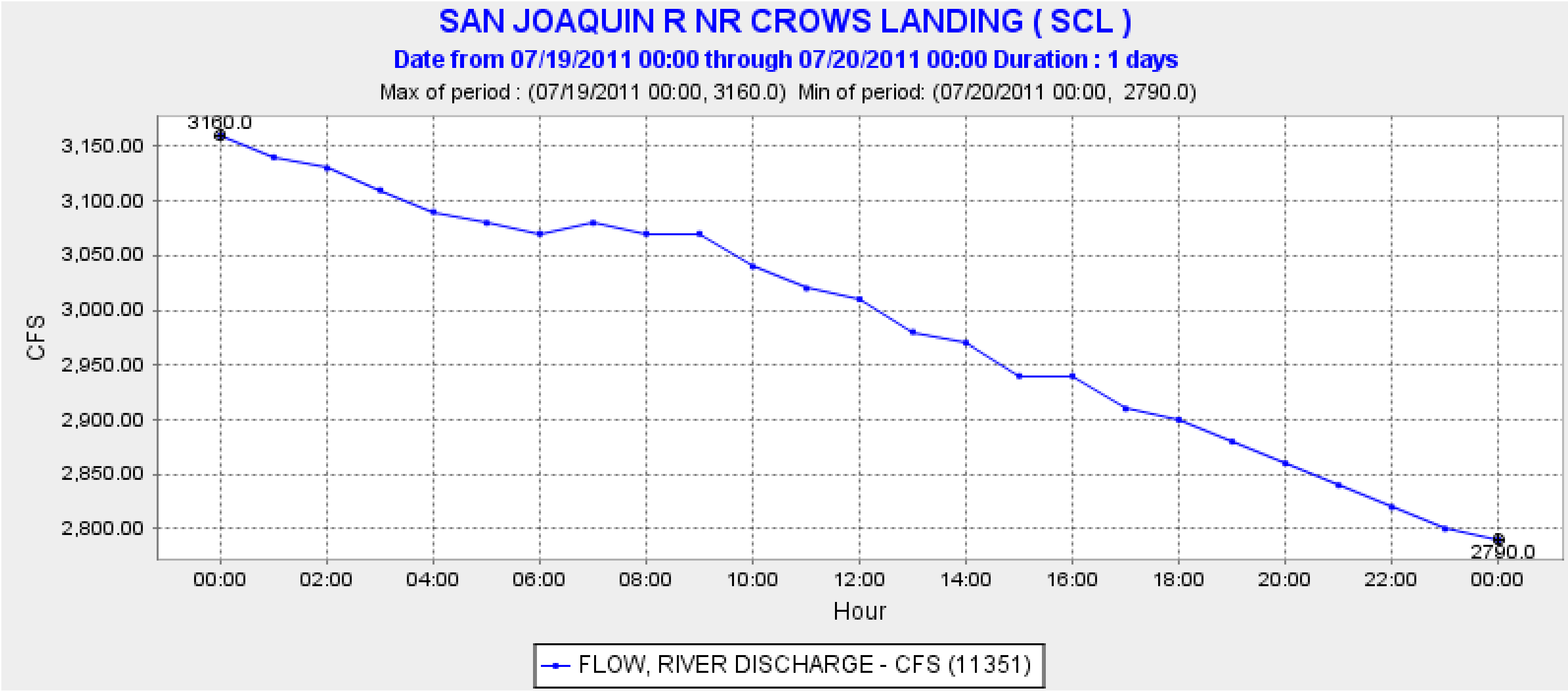

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Exhibit B